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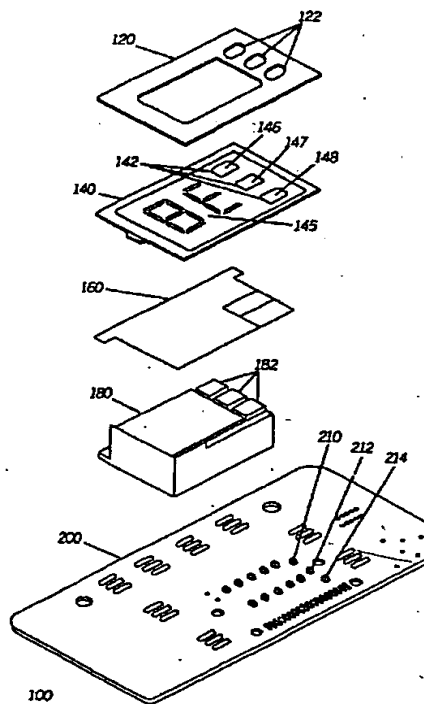
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Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: LCD SYSTEM WITH INTEGRATED ANNUNCIATOR

(57) Abstract

A display system (100) includes a liquid cristal display (140) which incorporates annunciator areas (142). Each annunciator area (142) has an aperture (146, 147, 148), independently controlled, to allow the passage of light through the annunciator area (142). Independently controlled illumination (160, 210, 212, 214) is positioned behind each annunciator area (142). The passage of light through each annunciator area (142) is controlled by opening and closing the aperture (146, 147, 148).



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LCD SYSTEM WITH INTEGRATED ANNUNCIATOR

Technical Field

10 This invention relates in general to liquid crystal displays and in particular to an LCD annunciator arrangement.

Background

The present invention is related to the incorporation of annunciators into a liquid crystal display (LCD) assembly.
15 Traditionally, such annunciators were housed in modules separate from the LCD assembly. However, the incorporation of annunciators into the LCD assembly has been pursued because of a demand for a more efficient use of available space as a result of product miniaturization, and because of the desire to centralize information devices.

20 There exist inherent problems with closely spaced and separately controlled annunciators which use color to convey additional information. The inherent problems include poor contrast when these annunciators are viewed in direct sunlight or bright ambient light. This is commonly termed "color washout." This problem is particularly
25 acute when light emitting diodes are used to provide back lighting. Color washout may be partially addressed by using a reflector positioned on the rear of the LCD, colored to reflect the desired color for the annunciator, in conjunction with incandescent lamps for back lighting. Color contrast is improved but other problems persisted.

30 One such problem exist when the annunciators are viewed in low light. Light intended for a particular annunciator must be specifically targeted to that annunciator display area to avoid inadvertent illumination of adjacent annunciators. This problem is commonly known as "color bleeding." Color bleeding also can occur from back
35 lighting needed to view the main portion of the LCD. Additionally, it is desirable to use light emitting diode, rather than an incandescent lamp for back lighting, as the former is more reliable and has a longer life.

Thus, a LCD system which incorporates annunciators, and which provides sharp contrast in bright light, while producing similarly sharp

images in low light, was long desired in the art. Furthermore, the use of light emitting diodes for back lighting was very desirable because of the relative low manufacturing cost, better reliability, and longer life, of light emitting diodes versus incandescent lamps.

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Summary of the Invention

The invention is a display system including a liquid crystal display which incorporates annunciator areas. These annunciator areas comprise controllable apertures for controlling passage of light through each annunciator areas and light blocking means for selectively closing
10 the apertures in response to a first control signal. Each annunciator is independently lighted by illuminator means positioned behind each annunciator area. The passage of light generated by the illuminator means is controlled by closing the apertures through the light blocking
15 means.

Brief Description of the Drawings

FIG. 1 is a an exploded perspective view of a LCD system with integrated annunciators.

20 FIG. 2 is a block diagram of a radio incorporating the LCD system with integrated annunciators.

Detailed Description of the Preferred Embodiment

While the specification concludes with claims defining the
25 features of the invention that are regarded as novel, it is believed that the invention will be better understood from a consideration of the following description in conjunction with the drawing figures, in which like reference numerals are carried forward.

30 Referring to FIG. 1, the LCD 140 is generally flat and planar with a two character display in the main display area 145, and annunciator areas 142 positioned adjacent to the main display area 145. The LCD 140 is light transmissive, i.e., light is able to pass through the body of the LCD 140. Liquid crystal displays are often implemented such that characters
35 or other symbols are displayed using a positive display image, i.e., the general background on the liquid crystal display reflects ambient light while particles activated within the liquid crystal display blocks the reflection of light in the shape of the desired characters or symbols. Thus,

the characters or symbols appear dark or black to a user. The LCD 140 has a negative display image, i.e., the general background does not reflect light. When characters or symbols are to be displayed, particles within the LCD 140 are activated to allow light to pass through the LCD 140 in the shape of the characters or symbols desired. The annunciator areas 142 within the LCD 140 also have a negative image display as described above. The particles within the annunciator areas 142 function as a light blocking means. Other light blocking means, such as a mechanical device behind each annunciator area 142, are possible.

10 The LCD 140, including the annunciator areas 142, is overlaid with a bezel 120. Annunciator windows 122 are excised on the bezel 120. The bezel 120 is overlaid on the LCD 140 such that the annunciator windows are located over the annunciator areas. The annunciator windows 122 are designed to delineate the desired symbols or characters for the
15 annunciator areas 142. For example, if the characters "Tx" are to be shown as an annunciator, the annunciator window would be excised to allow the passage of light in the shape of "Tx". A separate bezel 120 is not required for this invention. The function of the bezel 120 may be provided by integrally activating particles within the annunciator areas 142 in the
20 shape of the desired symbols, or by applying paint or the like to the LCD 140 to shape the annunciator areas 142.

Each annunciator area 142 has a controllable aperture 146,147,148 for controlling passage of light through the annunciator area 142. Referring to FIG. 2, a block diagram of a radio utilizing the LCD system
25 with integrated annunciators is shown. The apertures 146,147,148 can be selectively opened and closed in response to LCD control signals 502,504,506. Thus, the first aperture 146 responds to the first LCD control signal 502, the second aperture 147 responds to the second LCD control signal 504, and so on. The LCD control signals 502,504,506 instruct the
30 LCD driver 550 to activate or deactivate LCD segments (not shown) within the annunciator areas 142.

Referring back to FIG. 1, positioned behind the annunciator areas 142 are light sources 210,212,214, which can independently light each annunciator area 142. The light sources 210,212,214 used are light
35 emitting diodes (LED). However, other light sources such as incandescent lamps are possible. For a multi-colored application, the multi-colored LEDs 210,212,214 are selected to provide the desired color for each annunciator area 142. A lightpipe 180 is used to guide light from each

LED 210,212,214 to the targeted annunciator area 142. The lightpipe 180 has individual light guides 182 to reduced undesired light dispersion to other annunciators areas 142, or other areas on the LCD 140.

Referring to FIG. 2, the LED 210,212,214 for each annunciator area
5 142 is independently controllable and can be turned on and off through LED driver 560. Thus, the first LED 210 responds to first LED control signal 512, the second LED 212 responds to the second LED control signal 514, and so on. The LED control signals 512,514,516 control whether the LED 210,212,214 for each annunciator area 142 is on or off.

10 A reflector 160 is included to address the problem of poor color contrast for the annunciator area 142 in bright light situations. In this application, the reflector 160 is positioned between the LCD 140 and the lightpipe 180. The reflector 160 is independently colored for each
15 annunciator area 142 and reflects light in the color desired for each annunciator area 142. The reflector 160 also allows the passage of light from the LEDs 210,212,214 through the reflector 160 to the LCD 140. Note that other means of reflecting the desired color in bright light situations are possible. One such means is by painting the reflector directly on the LCD 140.

20 The light sources 210,212,214, and the reflector 160, are illuminators which can independently light each annunciator area 142. To minimize the inadvertent illumination of adjacent annunciator areas 142, the LCD control signals 502,504,506, and the LED control signals 512,514,516, are synchronized, such that when the aperture 146,147,148 for an annunciator
25 area 142 is closed, the LED 210,212,214 for that annunciator is turned off. Thus, if an annunciator area 142 is not to be illuminated, the first LCD control signal 502 causes the aperture 146 for that annunciator area 142 to close, and the first LED control signal 512 causes the LED 210 for that annunciator area 142 to be turned off. This substantially reduces the
30 problem of "color bleeding" present in the prior art.

The LCD control signals 502,504,506, and the LED control signals 512,514,516 are generated by controller 530 which is programmed to control the overall operation of the radio 500. The radio 500 communicates
35 messages over a radio frequency channel using receiver 520, transmitter 522, and antenna 525.

Thus, two major problems of closely spaced and separately controlled annunciators which use color to convey additional information have been solved. First, the synchronized shuttering of the aperture

146,147,148 for an annunciator area 142 in conjunction with the enabling and disabling of the light source 210,212,214 for that annunciator area 142, addresses the color bleeding problem. Second, the simultaneous use of a color reflector 160 addresses the problem of poor color contrast in bright
5 light situations.

While the preferred embodiments of the invention have been illustrated and described, it will be clear that the invention is not so limited. Numerous modifications, changes, variations, substitutions and equivalents will occur to those skilled in the art without departing from
10 the spirit and scope of the present invention as defined by the appended claims.

Claims

- 5 1. A liquid crystal display system, comprising:
 a liquid crystal display including:
 a plurality of annunciator areas comprising controllable
apertures for controlling passage of light through said annunciator
areas; and
10 light blocking means for selectively closing said apertures
in response to a first control signal; and
 illuminator means positioned behind said annunciator area for
independently lighting each of said plurality of annunciator area.
- 15 2. A liquid crystal display system as defined in claim 1, wherein
said annunciator area comprises a negative image display area.
3. A liquid crystal display system as defined in claim 1, wherein
said illuminator means comprises at least one light source responsive to
20 a second control signal for turning the at least one light source on and
off.
4. A liquid crystal display system as defined in claim 3, wherein
said first control signal and said second control signal are synchronized
25 to turn off said light source for said annunciator area when said
aperture for said annunciator area is closed.
5. A liquid crystal display system as defined in claim 1, wherein
said illuminator means comprises a plurality of multi-colored light
30 sources positioned behind said annunciator areas.
6. A liquid crystal display system as defined in claim 5, wherein
said light source comprises a light emitting diode.

7. A liquid crystal display system as defined in claim 5, further comprising:

- 5 a color reflector interposed between said rear surface of said annunciator area and said light source; and
said color reflector is independently colored for said annunciator area, said color reflector matching the color of said light source for said annunciator area.

8. A liquid crystal display system, comprising:
a liquid crystal display;
said liquid crystal display comprising a plurality of annunciator
areas comprising controllable apertures for controlling passage of light
5 through said annunciator areas;
said liquid crystal display further comprising light blocking
means for selectively closing said apertures in response to a first control
signal;
illuminator means positioned behind said annunciator area for
10 independently lighting each of said plurality of annunciator area;
said annunciator area comprises a negative image display area;
said illuminator means comprises at least one light source
responsive to a second control signal for turning the at least one light
source on and off;
15 wherein said first control signal and said second control signal
are synchronized to turn off said light source for said annunciator area
when said aperture for said annunciator area is closed;
said illuminator means comprises a plurality of multi-colored
light sources positioned behind said annunciator areas;
20 said light source comprises a light emitting diode;
a color reflector interposed between said annunciator area and
said light source; and
wherein said color reflector is independently colored for said
annunciator area, said color reflector matching the color of said light
25 source for said annunciator area.

9. A radio, comprising:

communication means for communication messages over a radio frequency channel;

5 a liquid crystal display for displaying messages including:

a plurality of annunciator areas comprising controllable apertures for controlling passage of light through said annunciator areas; and

10 light blocking means for selectively closing said apertures in response to a first control signal; and

an illuminator means positioned behind said annunciator area for independently lighting each of said plurality of annunciator area.

10. A radio as defined in claim 9, wherein:

15 said annunciator area comprises a negative image display area; and wherein said illuminator means comprises at least one light source responsive to a second control signal for turning the at least one light source on and off; said first control signal and said second control signal being synchronized to turn off said light source when said aperture for
20 said annunciator area is closed.

11. A radio, comprising:
communication means for communicating messages over a radio frequency channel;
- 5 a liquid crystal display for displaying messages including:
a plurality of annunciator areas comprising controllable apertures for controlling passage of light through said annunciator areas, and light blocking means for selectively closing said apertures in response to a first control signal; and
- 10 an illuminator means positioned behind said annunciator area for independently lighting each of said plurality of annunciator area;
said annunciator area comprises a negative image display area;
said illuminator means comprises at least one light source responsive to a second control signal for turning the at least one light
- 15 source on and off;
wherein said first control signal and said second control signal are synchronized to turn off said light source for said annunciator area when said aperture for said annunciator area is closed;
said illuminator means comprises a plurality of multi-colored
- 20 light sources positioned behind said annunciator areas;
said light source comprises a light emitting diode;
a color reflector interposed between said annunciator area and said light source; and
- 25 wherein said color reflector is independently colored for said annunciator area, said color reflector matching the color of said light source for said annunciator area.

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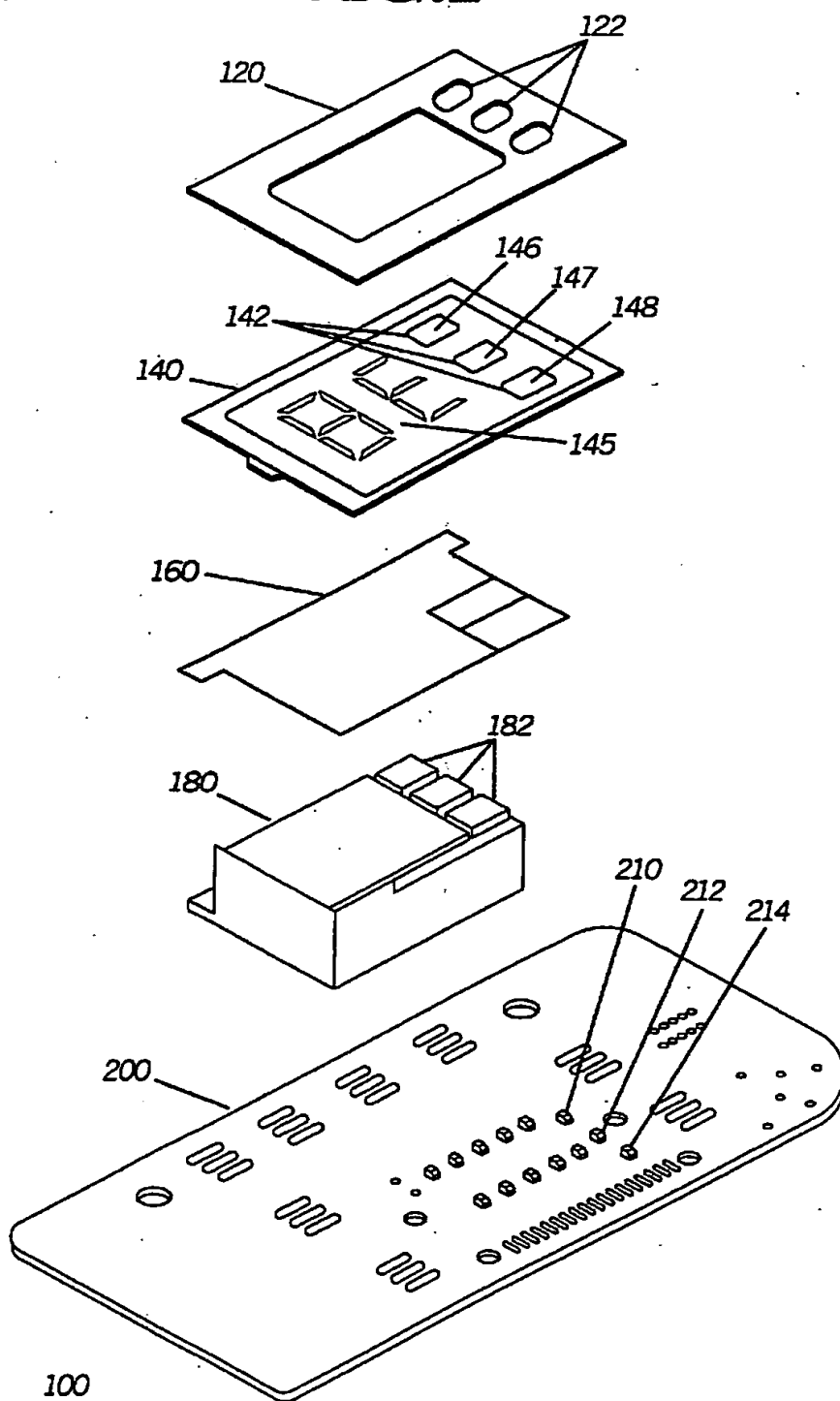
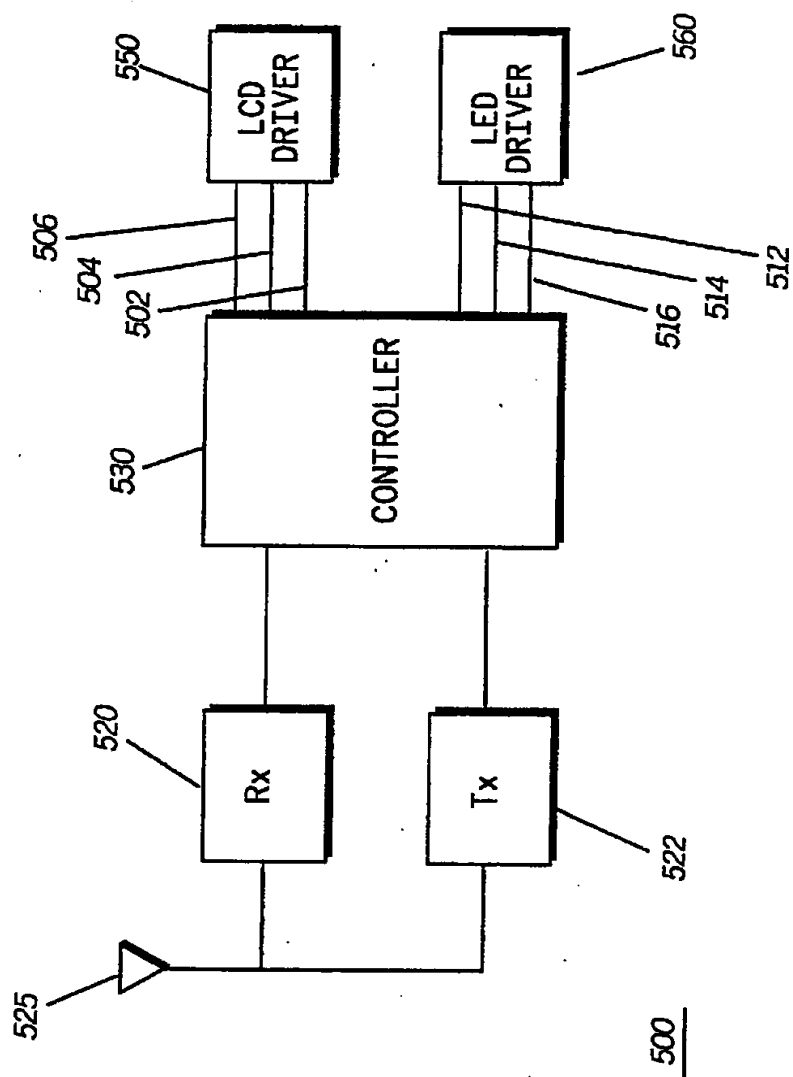
FIG. 1

FIG. 2



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/02876**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(S) : H04B 1/38.

US CL : 455/90; 345/38, 88.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 455/90, 89, 157.2, 158.4, 158.5, 159.1, 159.2, 226.4; 345/38, 88, 39, 40, 50, 87; 340/286.11, 815.1, 815.03, 701, 765.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Please See Extra Sheet.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US, A, 5,063,379 (FABRY et al) 05 November 1991, see figures 1, 3, column 1, line 40 through column 2, line 45, columns 3-5.	1-8 --- 9-11
Y	US, A, 5,115,182 (EHMKE et al) 19 May 1992 See figures 7a-7b, column 11, lines 16-19.	9-11
A	US, A, 4,617,562 (KLOTZ) 14 October 1986 See abstract, columns 2-3.	1-11
A	US, A, 4,514,920 (SHAFRIR et al) 07 May 1985 See figure 3, column 2.	1-11

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:	* T	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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Date of the actual completion of the international search

03 JUNE 1994

Date of mailing of the international search report

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B. FIELDS SEARCHED

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Name of data base: Automated Patent System (APS)

Search terms used: (LCD (p) annunciator#) and (telephone or radio)